Information Technology Diffusion: A Comparative Case Study of Intranet Adoption

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Abstract-This exploratory study identifies factors that influence the adoption and diffusion of intranet technology. A comparative case study of bipolar organizations is used to identify crucial implementation factors and create an innovation adoption model. A strategic approach for the adoption and diffusion of intranet technology is then presented.

I. INTRODUCTION

An intranet is an organization's internal computer network protected from the Internet by a firewall. The Gartner Group reports that the implementation of an enterprise-wide intranet can lead to increased accessibility to current information, the ability to work off-site, prestige, competitive advantage, reduced maintenance expenses, increased employee satisfaction and a Return on Investment (ROI) of over 1000 percent. The current design uses the client-server architecture, with a Hypertext Transport Protocol (HTTP) server and a web-browser as the client. TCP/IP is the foundational protocol. The HTTP server delivers static or dynamic web pages. Dynamic web pages allow query and transactional processing of information contained in a Data Base Management System (DBMS). The web-based model creates a universal interface for all types of organizational computers.

There has been little scientific research on the process of successful intranet implementation. Although a large body of literature on information systems strategy in organizations exists, almost all of this literature is concerned with prescriptive methods and frameworks aimed at aiding management in the formulation of strategy. A much smaller body of work [8] and [12] studies how the process of Information Systems (IS) strategy links to implementation [16]. More research dealing with the implementation of new technology in organizations is needed. To support this goal, this paper will conduct exploratory research to identify the factors that influence the adoption and diffusion of intranet technology and present a recommended approach for strategic adoption and diffusion.

A literature review of innovation and implementation is conducted in the next section. Section III describes the methodology used to gather information. A comparative analysis is conducted in section IV and section V presents a recommended approach for adoption.

II. THEORETICAL BACKGROUND AND LITERATURE REVIEW

Innovation is a new way of doing things. Mohr [11] states that an organization must possess and be willing to commit the resources needed to implement a new technology for it to be successful. He writes that "Innovation = Motivation times Resources".

Lewin [9] created a three-step sequential model that describes how processes are changed. The present behavior is "unfrozen", then it is "changed" to develop a new behavior and finally "refrozen" to reinforce the new behavior. He suggests there are multiple forces for change and for maintaining the status quo [15]. Forces for change:

- new technology
- better raw materials
- competition from other groups - survival
- supervisor pressures

Forces that inhibit change:

- group performance norms
- fear of change
- few external threats - member complacency
- well-learned skills.

Beath [2] believes that organizational members need to identify with a champion who spearheads the change to enable "unfreezing".

Cooper and Zmud [4] defined IT implementation as "an organizational effort directed toward diffusing appropriate information technology within a user community." They developed a six-staged model of IT implementation based on Lewin's work:

- *Initiation*: Active and /or passive scanning of problems/opportunities.
- *Adoption*: Negotiations for backing IT application implementation.
- *Adaptation*: IT application and organizational procedures are revised.
- *Acceptance*: Organizational members are induced to commit to IT application.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
AUG 1999		**00-00-1999 to 00-00-1999**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Information Technology Diffusion: A Comparative Case Study of Intranet Adoption	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Postgraduate School,Monterey,CA,93943**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Proceedings of the Portland International Conference on Management of Engineering and Technology, PICMET 99, Portland, OR, 25-29 July, 1999

14. ABSTRACT
This exploratory study identifies factors that influence the adoption and diffusion of intranet technology. A comparative case study of bipolar organizations is used to identify crucial implementation factors and create an innovation adoption model. A strategic approach for the adoption and diffusion of intranet technology is then presented.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**5**	

- *Routinization*: Usage of the IT application is encouraged as a normal activity.
- *Infusion*: Increased effectiveness obtained by using the IT.

They also described five major contextual factors that impacted each stage in the process:

- user community (job tenure, education, resistance to change)
- organization (specialization, centralization, and formalization)
- technology being adopted (complexity)
- task to which the technology is being applied (task uncertainty, autonomy)
- organizational environment (uncertainty, inter-organizational dependence)

Rogers [14] designed a five-stage innovation process for organizations: (1) *Agenda-setting*, (2) *Matching*, (3) *Redefining/Restructuring*, (4) *Clarifying*, and (5) *Routinizing*. He states that champions are so crucial to the success of innovation in organizations that new ideas find a champion or die.

III. METHODOLOGY

Case studies were chosen because they provide the ability to discover new contextual factors and enable longitudinal study. Polar types were selected "to exploit planned opportunism because this approach produces interesting research as well as an excellent opportunity for comparisons" [13]. Archives, interviews, and personal observations were used to create the qualitative data. Quantitative statistical comparisons based on Likert scale questionnaires were then used to triangulate the data and compare the case studies [5], [1].

A. *Model Development*

A customized model was created to help identify and measure factors in the case studies that influence innovation. It was designed by modifying Cooper and Zmud's model as well as using an approach adopted by Liu Sheng [10]:

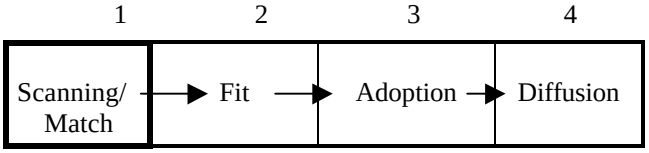

Fig 1: Organizational Innovation Adoption Process

The four-step process includes:

1. *Scanning/Matching*: Either an opportunistic approach that scans for new ideas or an approach that scans for innovative solutions for existing problems.
2. *Fit*: The innovation is redesigned to fit the organization's needs. Political negotiations are conducted to gain support for the match.
3. *Adoption*: Initial application use. Identification of a champion. Users are encouraged to regularly use the new innovation.
4. *Diffusion*: The IT application is spread throughout the organization in modified ways to increases overall efficiency or to solve additional problems.

B. *Data Collection*

Archival data was reviewed to provide longitudinal information. Quantitative data from both sites was obtained through the use of questionnaires. Qualitative information was obtained through observation and from interviews with users, computer specialists, executive board members and students. This data is used for comparison of the case studies in section IV.

1) Case One: The Naval Postgraduate School: The first study was conducted at the United States Navy's research university, the Naval Postgraduate School (NPS) *http://www.nps.navy.mil*. Approximately 1400 masters and Ph.D. students are enrolled in various technical programs. Students from all branches of the United States Military, the Department of Defense, and numerous foreign countries attend. There are 1500 full-time staff and faculty with approximately three thousand five hundred computers connected to the campus network.

2) Case two: Sandia National Laboratories: Sandia National Laboratories (*http://www.sandia.gov*) was chosen because it is structurally similar to the NPS and was named one of the nation's top six intranet sites for its excellence in execution, innovative use of technologies and demonstrated intranet benefits. Sandia is a multi-program national security laboratory operated by Sandia Corporation for the U.S. Department of Energy. It works in partnership with universities and industry to enhance the security, prosperity, and well being of the nation. Sandia employs approximately 6,600 technical and administrative employees and has approximately eight thousand workstations connected to its computer network.

IV. COMPARATIVE FINDINGS

A. *General characteristics*

The two sites provided an excellent comparison because of their similar mission and hierarchical organization structure. Sandia has done an excellent job of adoption and

diffusion while the Naval Postgraduate School's pace has been much slower. Information sharing at both sites is somewhat inhibited because the departments are not highly interdependent and there is a need for some security compartmentalization. The general technological expertise of both groups is excellent. There is a high level of heterogeneity between workstations at both sites with multiple versions of Windows, UNIX and Apple workstations supported as well as multiple Network Operating Systems.

There are notable differences. Sandia has more than twice the number of computer personnel and workstations as NPS and its network was upgraded just prior to the introduction of web technology. NPS's network is currently undergoing a major upgrade to increase bandwidth and enhance reliability. A Chief Information Officer (CIO) controls all Sandia's computer personnel, while NPS has about one-third of its computer personnel centrally managed with the remaining assigned to the departments. Sandia developed a strategic plan for intranet implementation and committed two full-time programmers who named themselves the Engineering Viewing Environment (E.V.E.) Team; NPS did not. Table I is an overall general comparison of the two sites.

Table I
NPS and Sandia Characteristics

	NPS	Sandia
Mission	Education and Research	Research
Management Structure	Hierarchical	Hierarchical
Decision Process	Centralized	Centralized
Culture Supporting Change	Low	Medium
Intranet Strategic Plan	None	Formal
Inter-Departmental Information Sharing	Low	Moderate
Network Management	Centralized	Centralized
Computer Personnel Management	Distributed	Centralized
Computer Personnel	125	400
Technological Expertise	High	High
Network Capability	Being upgraded	Excellent
Number of Servers and Workstations	3500	8000
Workstation Heterogeneity	High	High

B. Scanning/Matching Comparison

Both NPS and Sandia used informal opportunistic approaches to discover and acquire intranet technology; they chose to match the innovation with an enterprise-wide need. There was one major difference. The Sandia match was a simple solution initially adopted in one department using a web site to transfer files. The Naval Postgraduate School's match was a more complex solution (an enterprise telephone and email directory) that required information sharing between all the campus departments and executive board approval for adoption. Table II is an overall comparison of the scanning/matching stage.

Table II
Scanning/Match Stage Comparison

	NPS	Sandia
Scanning Process	Informal	Informal
Scanning – Solution-solving/ Opportunistic	Opportunistic	Opportunistic
Matching problem	Dynamic access to Personnel Information (E-mail, Telephone #)	Departmental download of Static Information
Information Source	Peer Demonstration	Peer Demonstration
Solution Potential	Enterprise-Wide	Enterprise-Wide
Decision to adopt	Executive Board	Departmental

C. *Fit Comparison*

There was quite a difference in the two case studies. Since Sandia's solution was initially adopted in a single department, resources and personnel were easily dedicated and the design was quickly approved. The Naval Postgraduate School chose a complex enterprise solution that required executive support and interdepartmental cooperation. Only one part-time designer was assigned. The political complexity of the project made this stage very time-consuming and no resources were available to cultivate additional champions. Table III is a comparison of the fit stage characteristics.

Table III
Fit Stage Comparison

	NPS	Sandia
Management Support	Departmental	Departmental
User Involvement	Limited	Actively requested
Design Personnel	One part-time	Two full-time
Internal Champion	Research Assistant	E.V.E Team
Resources Available	Minimum	Adequate
Technological Complexity	Moderate	Low

D. *Adoption Comparison*

The rate of adoption for the case studies provides a clear sign of the differences that exist between them. Sandia provided a simple and effective solution to a well-known single departmental problem. The E.V.E. Team aggressively demonstrated to potential users throughout the organization how an intranet could directly benefit them by creating custom web-based applications. Numerous department personnel became champions and system administrators were eager to learn the new technology. The Naval Postgraduate School provided very limited resources to their complex enterprise-wide solution. A single student created the application, which limited user involvement and provided no resources for organizational training. The result was a relatively low visibility champion, only moderate initial user support, and an inability to cultivate additional champions. Table IV provides a comparison of the adoption process.

Table IV
Adoption Stage Comparison

	NPS	Sandia
Scope of Project	Enterprise-Wide	Departmental
Rate of Adoption	Slow	Very fast
Internal Champion	Student	E.V. E. Team
Personnel Assigned	One Part-time	Two full-time
Training	Very Limited	Very Pro-Active
Adoption Success	Moderate	Excellent
User Support	Moderate	Enthusiastic
User involvement	Limited	Heavy

E. Diffusion Comparison

Diffusion occurred rapidly at Sandia because the initial intranet application was simple, very successful and created a broad base of support for further enterprise development. Grass roots personnel and executive board members were eager to find more opportunities to use this technology and accelerated enterprise intranet application development. An added benefit was that because the E.V.E team had been the harbinger of this technology, they were naturally looked to for future applications.

The Naval Postgraduate School's initial application was a complex, technically sophisticated system that was resisted by some users because it replaced a legacy system that was well liked. It did not create the broad base of user support for future intranet applications that Sandia enjoyed. NPS has improved their enterprise telephone and email directory program, responded to user's suggestions and is moving closer to achieving the critical mass needed for enterprise-wide intranet development. Table V provides a comparison of diffusion characteristics.

Table V
Diffusion Stage Comparison

	NPS	Sandia
Rate of Diffusion	Slow but building	Very Rapid
Management Support	Minimal	Excellent
User support	Moderate	Excellent
Internal Champions	Two Central Computer Staff Members	Numerous - all levels
Personnel Assigned	Two full-time	Ten full-time
Centralized Control	Minimal	E.V.E. Team
Additional Applications	Some at Design Stage	Several
Information Sharing	Moderate	Good
Incorporation into organization culture	Minimum	Fully
Training	Limited	Provided
Rewards	None	National Recognition

V. RECOMMENDED APPROACH

A. Scanning/Matching

Opportunistic and need scanning must be continuous. Individuals should be assigned from a central computer department to continuously conduct opportunistic and need scanning. Active innovation identification will empower the organization to stay at the forefront of innovation, reducing inefficiency and heterogeneity of solutions. Centralized evaluation of innovation leads to standardization and better diffusion. Ensure the end-users are involved in the match between innovation and need. Do not create a match just to experiment with a new technology. There should be a need.

B. Fit

Political support must be generated for the innovation. A champion must emerge who has the capability to allocate resources and the power to gather support for the new process. If support cannot be gained, drop the project. Adequate resources must be committed to the design team. In radical new technology, create a simple implementation first to create support for later complex solutions. Ensure user involvement is incorporated at all stages of the redesign.

C. Adoption

User support is the key to adoption. Demonstrate how this solution will benefit the user (easier, better, more fun). If it does not, it is not a good solution. Adequate resources must be committed to training and maintenance of the project. The champion must be visible, creditable and enthusiastic. Network bandwidth and reliability must also be adequate.

D. *Diffusion*

Full-time advocates of innovation change must be assigned to the process. Change agents must be encouraged to review all processes that could be enhanced by intranet technology. Training must be continued to encourage user inputs for changes that can be made. Rewards must be given to those who significantly contribute to the successful implementation of the innovation.

VI. CONCLUSION

The purpose of this paper has been twofold: (1) identify factors that influence the organizational adoption and diffusion of intranet technology and (2) recommend a strategic plan for its adoption and diffusion. A comparative case study was conducted between two sites: the Naval Postgraduate School which has struggled to adopt and diffuse intranet technology and Sandia National Laboratories which has been very successful, receiving national recognition for its intranet.

A customized model based on Lewin's [9] three-step sequential model for the change process and Cooper and Zmud's [4] six-staged model of IT implementation was created to help identify the important factors that affect implementation and study the process of intranet adoption and diffusion. With this new model, a comparison of the two case studies was completed in section four which led to a recommended approach for intranet implementation described in section five.

In conclusion, intranet technology is a complex tool kit of innovative ideas that must be custom-designed for each organization. Continuous scanning, a good match to a recognized need, a capable champion, a culture ready for change, and political support that produces adequate resources are important factors that must be attained before successful adoption and diffusion can be achieved.

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